

Specification

TRAFFIC INFORMATION COLLECTING SYSTEM FOR NAVIGATION
DEVICE

5 **Technical Field**

[0001]

The present invention relates to a traffic
information collecting method, and more particularly,
it relates to a technique to collect traffic
10 information such as a drive history of a vehicle on
which an in-vehicle type navigation device is mounted.

Background Art

[0002]

15 Patent Document 1 discloses a traffic information
collecting system in which an information center
receives information regarding driving conditions,
such as traffic jam information and road surface
information, having been collected by a vehicle (probe
20 car).

[0003]

Patent Document 1: Japanese Patent Laid-Open
Publication No. 2000-123289

25 **Summary of the Invention**

Problems to be solved by the Invention

[0004]

Even if the technique as disclosed by the Patent Document 1 is applied to each individual user's vehicle so as to collect drive history, each user does not necessarily provide the drive history information to the information center in a positive manner. Drive history information of a vehicle is significant for the information center that collects traffic information. However, for each individual, an advantage to provide the history information is not clearly defined. Therefore, it is not easy to collect history information of individual users by using the technique as disclosed by the Patent Document 1.

15 [0005]

The present invention has been made in view of the above situations, and an object of the present invention is to provide a technique to easily collect traffic information such as drive histories of individual users.

Means for Solving the Problems

[0006]

In order to solve the above problems, a traffic information collecting method according to the present

invention updates map data, upon receipt of history information provided from a navigation device, the history information including drive history of the moving object on which the navigation device is mounted,
 5 operation history of the moving object or the navigation device, and the like. Specifically, this method is configured as the following.

[0007]

The traffic information collecting method in the
 10 information center according to the present invention allows a storage unit in the information center to store map data. Then, this traffic information collecting method executes a judging step which judges whether or not history information is recorded in a
 15 data recording medium which is mountable on the navigation device, and a map updating step which writes the map data into the data recording medium when the judging step determines that the history information is recorded in the data recording medium.

20 [0008]

It is also possible to store statistical traffic information (traffic information such as link travel time, being created by statistically processing the past traffic information) in the storage unit in the
 25 information center. Then, this traffic information

collecting method may execute the judging step to judge whether or not the history information is recorded in the data recording medium which is mountable on the navigation device, and statistical traffic

5 information updating step which writes the statistical traffic information in the data recording medium, when the judging step determines that the history information is recorded in the data recording medium.

[0009]

10 The data recording medium is demountable (removable) from the navigation device.

[0010]

In addition, a history information collecting method of the navigation device, on which the data
15 recording medium used in the traffic information collecting method of the information center is mounted, allows the navigation device to execute a history information collecting step which collects the history information, and a history information recording step
20 which records in the data recording medium, the history information collected by the history information collecting step.

[0011]

An information processing method of the
25 navigation device according to the present invention

is provided with a connection means which connects the navigation device with the information center via a network, and a storage unit which stores map data. Then, the method executes, history information
 5 collecting step which collects history information, sending step which sends the history information collected by the history information collecting step to the information center, a map data receiving step which receives map data from the information center,
 10 and replacing step which replaces the map data being recorded in the data recording medium, with the map data received by the map data receiving step.

Effect of the Invention

15 [0012]

According to the present invention, it is possible to provide a technique to easily collect traffic information such as drive histories of individual users.

20

Brief description of drawings

[0013]

FIG. 1 is a schematic configuration diagram showing a traffic information collecting system to which one
 25 embodiment of the present invention is applied.

FIG. 2 is a diagram showing a hardware configuration of an information center and a terminal machine.

FIG. 3 is a diagram showing a configuration of information that is stored in a storage unit of the information center.

FIG. 4 is a schematic configuration diagram showing an in-vehicle type navigation device 1000.

FIG. 5 is a diagram showing a configuration example of information that is recorded in a data recording medium.

FIG. 6 is a diagram showing a configuration example of drive information every predetermined period of time (predetermined distance).

FIG. 7 is a diagram showing a configuration example of drive information every time going over a link.

FIG. 8 is a diagram showing a hardware configuration of processing unit 1 of the in-vehicle type navigation device.

FIG. 9 is a flow diagram showing a functional configuration of the processing unit 1 of the in-vehicle type navigation device.

FIG. 10 is a flow diagram showing a schematic flow of a process of the traffic information collecting system.

FIG. 11 is an illustration showing a transition

example of screen displays in setting information to be recorded.

FIG. 12 is a flow diagram showing a flow of process to generate drive history information.

5 FIG. 13 is a flow diagram showing a process to collect history information and a process to update map data, which are performed by the information center.

FIG. 14 is an illustration showing a transition example of screen displays of terminal machine in the
10 process to update the map data.

FIG. 15 is a flow diagram to show a flow of process to create statistical traffic information that is performed by the information center.

FIG. 16 is a flow diagram showing a flow of the process
15 in S310 (classification of probe information) as shown in FIG. 15.

FIG. 17 is a flow diagram showing a flow of the process in S320 (manipulation of probe information having been classified) as shown in FIG. 15.

20 FIG. 18 is a schematic diagram of the traffic information collecting system according to the second embodiment.

FIG. 19 is a flow diagram of a process in which the in-vehicle type navigation device transmits history
25 information to the information center, in the traffic

information collecting system according to the second embodiment.

FIG. 20 is an illustration showing a configuration example of the history information to be uploaded in the information center.

FIG. 21 is an illustration showing a configuration example of the history information to which identifiers are attached, indicating that the information has been uploaded.

FIG. 22 is a flow diagram showing a process to manage the history information of the information center, in the traffic information collecting system according to the second embodiment.

Preferred Embodiments of the Invention

[0014]

Hereinafter, one embodiment of the present invention will be explained, with reference to the accompanying drawings.

20

<<First Embodiment>>

Initially, the first embodiment will be described.

[0015]

FIG. 1 is a schematic diagram of the traffic

information collecting system to which one embodiment of the present invention is applied. As illustrated, the traffic information collecting system according to the present embodiment incorporates, information center 5000 which collects traffic information, a terminal machine 5030 which is connected to the information center 5000 via a network, and an in-vehicle type navigation device 1000 which is mounted on a vehicle 100. The terminal machine 5030 may be a terminal machine 5031 installed at an automobile related business place, such as a car dealer, a terminal machine 5032 installed at a business place basically not related to automobile, such as a convenience store, and a terminal machine 5033 such as personal computer, which is installed at home of user, and the like. Sending and receiving of information between the in-vehicle type navigation device 1000 and the terminal machine 5030 is carried out via a data recording medium 800, which is rewritable and detachable from the in-vehicle type navigation device 1000.

[0016]

FIG. 2 is a diagram showing a hardware configuration of the information center 5000 and the terminal machine 5030. As illustrated, the

information center 5000 and the terminal machine 5030 are implemented by a computer system that incorporates a processing unit 901, memory 902, external storage unit 903 such as HDD, reader/writer 904 which
 5 reads/write information from/to the data recording medium 800, an output unit 905 such as display and printer, input unit 906 such as keyboard, mouse, and scanner, and a network communication unit 907 which sends and receives information to/from another
 10 equipment via the network. It is to be noted that various processing of the information center 5000 and the terminal machine 5030, which will be described below, can be established when the processing unit 901 executes a program loaded on the memory 902.

15 [0017]

FIG. 3 is a diagram showing a configuration of the information that is stored in the external storage unit 903 of the information center 5000. As illustrated, there are stored in the external storage
 20 unit 903 of the information center 5000, user information 501, the latest map data 502, probe information 503, and statistical traffic information 504. User information 501 includes information of user individuals, such as code identifying the user
 25 (user ID), full name and address of the user. The

latest map data 502 includes updated map data being created periodically.

[0018]

The latest map data 502 includes an
 5 identification code (mesh ID) of a mesh area that is obtained by dividing the map into predetermined areas, and link data of each of links constituting roads that are contained in the mesh area. The link data includes identification code of a link (link ID), coordinate
 10 information of two nodes constituting the link (start node, end node), link length being a length of the link, type information of a road that contains the link, and the like. The latest map data 502 further includes spot data that is used in spot searching process of
 15 the in-vehicle type navigation device 1000. As to a specific spot (for example, a point available as a landmark), data of the spot includes name, coordinate information, and the like, of that specific spot. In addition, the map data includes information which
 20 specifies the data creation date (version information, and the like).

[0019]

The probe information 503 includes history information collected by the in-vehicle type
 25 navigation device 1000 such as drive history of the

vehicle 100.

[0020]

The statistical traffic information 504 is traffic information that is created by statistically
 5 processing the probe information 503 having been accumulated. The statistical traffic information 503 includes link travel time (and/or travel speed (moving speed)) being associated with a collecting condition (date and time, weather, and the like) and the link
 10 ID.

[0021]

FIG. 4 is a schematic configuration of the in-vehicle type navigation 1000. As illustrated, the in-vehicle type navigation 1000 according to the
 15 present embodiment includes a processing unit 1, display 2, data storage unit 3, voice I/O unit 4, input unit 5, wheel rotation speed sensor 6, geomagnetic sensor 7, gyro sensor 8, GPS (Global Positioning System) receiver 9, in-vehicle LAN unit 11, and network
 20 connection unit 10.

[0022]

The processing unit 1 is a central unit which conducts various processing. For example, it detects a current position based on the information outputted
 25 from the various sensors 6 to 8 and the GPS receiver

9, and reads map data required for displaying from the map data storage unit 3 according to the current position information thus obtained. In addition, the processing unit 1 expands the map data thus readout
5 to graphics to be displayed on the display 2, with a mark superimposing thereon which indicates the current position. The processing unit 1 further utilizes the map data stored in the map data storage unit 3, makes a search for an optimum route (recommended route) which
10 connects a destination indicated by the user with the current position (departure place), and guides the user by use of the voice I/O unit 4 and the display 2.

[0023]

15 The display 2 is a unit which displays the graphics information generated by the processing unit 1, and incorporates a CRT, a liquid crystal display, and the like. It is general that a signal S1 to connect the processing unit 1 with the display 2 is RGB signal
20 or NTSC (National Television System Committee) signal.

[0024]

The data storage unit 3 incorporates a data storage medium 800, such as CD-RW, DVD-RW, HDD, and IC card, which is rewritable and detachable from the
25 in-vehicle type navigation device 1000.

[0025]

FIG. 5 is a diagram showing a configuration example of the map data 310, user information 320, history information 330, and the like, which are stored in the data recording medium 800. The map data 310 may not be the latest one, but it has the same configuration as the latest map data 502 held by the information center 5000. The user information 320 includes information of user individuals, such as ID, name, address of the user who uses the in-vehicle type navigation device 1000.

[0026]

As shown in FIG. 5, the history information 330 includes drive history information 3310, operation history information 3320, route searching history information 3330, communication history information 3340, recording ratio information 3350, and the like.

[0027]

The drive history information 3310 includes drive history information 3311 every predetermined period of time (or distance), and drive history information 3312 every time going over a link. As shown in FIG. 6, the drive history information 3311 every predetermined period of time (or distance) includes measured date and time 33111, position of the vehicle

(latitude, longitude, mesh area, and the like) 33112, link ID 33113 on which the vehicle exists, and the vehicle information 33114. The vehicle information 33114 includes information items, such as ON/OFF information of parking brake, wiper, blinkers, and the like, and information collectable by in-vehicle type equipment such as lighting intensity sensor, exterior temperature, and engine speed.

[0028]

As shown in FIG. 7, the drive history information 3312 every time going over a link includes link entering date and time 33121, link ID 33122, vehicle information 33123, and link travel time 33124. The vehicle information 3312 includes, similar to the vehicle information 33114, information items, such as ON/OFF information of parking brake, wiper, blinkers, and the like, and information collectable by in-vehicle type equipment such as lighting intensity sensor, exterior temperature, and engine speed.

[0029]

Returning to FIG. 4, explanation will be continued further. The voice I/O unit 4 performs processing to convert a message to the user generated in the processing unit 1 into a voice signal and output thus converted signal. The voice I/O unit also

performs processing to recognize a voice from the user so that the description thereof is transferred to the processing unit 1.

[0030]

5 The input unit 5 is a unit to receive a directive from the user, and incorporates hardware switches such as a scrolling key and a scale change key, a joystick, a touch panel placed on the display, and the like.

[0031]

10 The sensors 6 to 8 and the GPS receiver 9 are utilized to detect a current position (user's vehicle position) on the in-vehicle navigation device. The wheel speed sensor 6 measures a distance according to a product by multiplying the circumference of the wheel
15 and the number of revolutions of the wheel which is subjected to the measurement. Further, an angle at which the moving object makes a turn is measured according to a difference between the number of revolutions of the pertinent wheel and that of the
20 other wheel in a pair. The geomagnetic sensor 7 detects a magnetic field held by the earth, and detects the bearings of the moving object. The gyro 8 includes an optical fiber gyro, a vibration gyro, and the like, and detects an angle at which the moving object makes
25 a turn. The GPS receiver 9 receives a signal from GPS

satellites, and measures distances between the vehicle and each of at least three GPS satellites and change rates of the distances, thereby measuring a current position, a travel direction and a travel azimuth of
5 the moving object.

[0032]

The in-vehicle LAN unit 11 receives various information items from various sensors that are attached to the vehicle 100, on which the in-vehicle
10 type navigation device 1000 is mounted. The various information items includes, for example, ON/OFF information of parking brake, wiper, blinkers, and the like, and information such as lighting intensity, exterior temperature, engine speed. Then, those
15 information items are transmitted to the history information processor 55 described below.

[0033]

The network connection unit 10 controls, for example, a wireless communication device such as
20 portable phone, being connected to the in-vehicle type navigation device 1000, and accesses the information center 5000 via wireless base station and a network such as public network and the Internet, which are not illustrated.

25 [0034]

FIG. 8 is a block diagram showing a hardware configuration example of the processing unit 1.

[0035]

As illustrated, the processing unit 1 has such
5 a structure that various devices are connected to one
another through a bus 32. The processing unit 1
includes a CPU (Central Processing Unit) 21 which
performs various processing such as numerical
calculation and controlling each device, an RAM
10 (Random Access Memory) 22 which stores map data and
computational data which are read out from the map data
storage unit 3, an ROM (Read Only Memory) 23 which
stores programs and data, a DMA (Direct Memory Access)
24 which performs data transmission between memories
15 and between each memory and each device, a drawing
controller 25 which performs graphics drawing and also
performing display control, a VRAM (Video Random
Access Memory) 26 which stores graphics image data,
a color pallet 27 which converts image data into RGB
20 signals, an A/D converter 28 which converts analog
signals to digital signals, an SCI (Serial
Communication Interface) 29 which converts serial
signals to parallel signals which are synchronized
with the bus, a PIO (Parallel Input/Output) 30 which
25 puts the parallel signals on the bus in synchronization

with the bus, and a counter 31 which integrates pulse signals.

[0036]

FIG. 9 is a diagram showing a functional structure
5 of the processing unit 1.

[0037]

As illustrated, the processing unit 1 includes a user operation analyzer 41, a route search section 42, a drive locus storage section 44, a display
10 processor 45, a current position calculator 46, a network communication section 50, and history information processor 55.

[0038]

The current position calculator 46 utilizes
15 distance data and angle data, which are obtained by integrating each of the distance pulse data S5 measured by the wheel speed sensor 6 and the angular acceleration data S7 measured by the gyro 8, and periodically calculate the current position (X', Y').
20 Then, map matching process using the map data is performed, thereby calculating the current position on the map.

[0039]

The user operation analyzer 41 receives a user's
25 request inputted into the input unit 5 to analyze the

description of the request, and controls each part of the processing unit 1 so that the processing in response to the request description is executed. In addition, the user operation analyzer 41 accepts
5 information of operations performed by the user against the vehicle (for example, ON/OFF information as to the blinker and the wiper, open and close information of the doors, lighting status information, brake operation information, accelerator operation
10 information, and the like), which have been collected via the in-vehicle LAN, and then transmits those information items to the history information processor
55.

[0040]

15 The route search section 42 makes a search for a route to reach the destination at the minimum cost (for example, travel time), out of routes connecting two specified points (the current position and the destination), by the use of the Dijkstra method or the
20 like. In addition, the route search section performs route guidance utilizing the route thus searched out.

[0041]

The drive locus storage section 44 stores as locus data, the current position information to which the
25 map matching processing has been applied, every time

the own vehicle runs for a predetermined distance.
The locus data is used to draw a locus mark on a
corresponding road on the map, along which the vehicle
has driven so far. For the drive locus storage unit
5 44, a memory such as RAM and SRAM, which is different
from the data recording medium 800, is employed.

[0042]

The display processor 45 generates a command for
displaying on the display 2. For example, the display
10 processor 45 receives from the data storage unit 3,
the map data in an area which is requested to be
displayed on the display 2, and generates map drawing
commands so as to draw a road, other map constituents,
the current position, the destination, and marks such
15 as an arrow for guiding route, in a scale and a drawing
mode, being specified by the user operation analyzer
41, or the like.

[0043]

The network communication section 50 sends and
20 receives information via the network, between the
navigation device 1000 and the information center 5000
or other information delivery center.

[0044]

The history information processor 55 collects
25 information to be recorded as history information 330,

and records the information in the data recording medium 800 via a data reader/writer, not illustrated. Further, the history information processor 55 reads out and edits the history information 330 recorded in
5 the data recording medium 800.

[0045]

The in-vehicle type navigation device 1000 configured as described above performs navigation process according to a user's directive. During this
10 process, the navigation device accumulates in the data recording medium 800, drive history of the vehicle, operation history of the user, route search history, communication history, and the like.

[0046]

15 **[Description of operations]**

Next, an operation of the traffic information collecting system with the above configuration will be explained. FIG. 10 is an illustration showing a schematic flow of a processing of the traffic
20 information collecting system according to the present embodiment.

[0047]

As illustrated, the in-vehicle type navigation device 1000 collects the history information 330, and
25 records the collected information into the data

recording medium 800 (S100). The data recording medium 800 demounted from the in-vehicle type navigation system is read by the terminal machine 5030. Then, the terminal machine 5030 receives a directive
5 from the information center 5000 to read and delete the history information 330 in the data recording medium 800, and perform map data rewriting into the latest one (S200). The data recording medium 800 processed by the terminal machine 5030 is installed
10 on the in-vehicle type navigation device 1000 again, to perform accumulation of history information 330 (S100). On the other hand, the information center 5000 accumulates the history information 330 received from the terminal machine 5030 as probe information
15 503, and generates statistical traffic information 504 on the basis of the probe information 503 thus accumulated. The information center 5000 transmits thus generated statistical traffic information 504 in response to a request from the in-vehicle type
20 navigation device 1000.

[0048]

Each of the above processes (S100 to S300) will be explained in detail in the following.

[0049]

25 [Process for collecting history information]

Firstly, a process for collecting the history information 330 (S100), which is executed by the in-vehicle type navigation device 1000, will be explained.

5 [0050]

The in-vehicle type navigation device 1000 firstly sets whether or not the history information 330 is to be recorded in the data recording medium 800. Since some users do not want the history information 330 is recorded, this setting is prepared so as to respond to such request. Specifically, as shown in FIG. 11, the history information processor 55 displays on the screen 201 for setting a decision whether or not the history information 330 is recorded, on the display 2 via the display processor 45. In this situation, the history information processor 55 displays an advantage which will be given to the user, if the history information is recorded. For example, a message 211 will be displayed, such as "RECORDING OF HISTORY INFORMATION WILL REDUCE CHARGE FOR UPDATING MAP DATA."

[0051]

If it is requested from the user via the input unit 5 not to record the history information, the history information processor 55 does not perform the

following history information creating process, so as not to record the history information 330 in the data recording medium 800.

[0052]

5 On the other hand, if recording of the history information 330 is requested, as shown in FIG. 11, the history information processor 55 displays on the display 2 via the display processor 45, a screen 220 for setting a type of information to be recorded. In
10 the example of FIG. 11, the history information processor 55 displays on the screen 220, a list of information candidates 221 to be recorded. It is to be noted that a selection of information item not to be recorded can be made by removing check 222. The
15 history information processor 55 sets the information item whose check 222 has not been removed so as to be recorded in the data recording medium 800 as history information 330, according to the following history information creating process.

20 [0053]

 According to the procedure as described above, when a setting of information to be recorded as history information 330 is made, the history information processor 5 performs a processing to create the history
25 information 330.

[0054]

FIG. 12 is a flow diagram showing a flow which creates drive history information 3310 in the history information 330.

5 [0055]

In general, this flow is constantly carried out while the power of the in-vehicle type navigation device 1000 is being on.

[0056]

10 The history information processor 55 keeps monitoring whether or not a predetermined period of time (a predetermined time, for example, 10 seconds) has elapsed, whether or not driving has reached a predetermined distance (a predetermined distance, for
15 example 100m), or whether or not the vehicle goes over a link (reaches a different link ID) (S102). If any of the above situations is determined as positive (Yes in S102), the history information processor 55 determines whether or not the information currently
20 collectable is recorded as history information 330 (S103). Specifically, the history information processor 55 does not record the currently collectable information, if the current date and time is within a time zone (for example midnight) that is configured
25 such that recording of history information is

unnecessary. Furthermore, the history information processor 55 does not record the currently collectable information as history information, either, if the current position is at a place where recording of history information is unnecessary, for example, on a very narrow road (a link with a road width of 5 meters or less), or on a road that is not recorded in the map data. Then, processing returns to S102 and it is continued. Other than the above case, the history information processor 55 determines that it is necessary to record the history information and shifts the process to S104. It is to be noted that date and time, and road type, which are assumed as not necessary to record history information, are predefined.

15 [0057]

In S104, in the case where it is determined that a predetermined period of time has elapsed in S102 or it is determined that a distance already driven has reached a predetermined distance, the history information processor 55 obtains from the current position calculator 46, the current position (latitude, longitude) and a link ID 33113 where the current position is located. In addition, the history information processor 55 further obtains the vehicle information 33114 (ON/OFF information as to blinker,

20

25

wiper, parking brake, and the like, open and close information of the doors, lighting status information, brake operation information, accelerator operation information, and the like), which is collected via
5 in-vehicle LAN.

[0058]

In the case where it is determined in S102 that the vehicle goes over a link, the history information processor 55 obtains link ID of the link from the
10 current position calculator 46, and further obtains vehicle information collected through the in-vehicle LAN.

[0059]

Next, the history information processor 55
15 determines whether or not the obtained information is configured by the user such that it is not recorded as history information. If there is an information item that is set as not to be recorded, that information item is excluded (S108).

20 [0060]

Next, the history information processor 55 judges whether or not the data recording medium 800 has a free space sufficient for recording thus collected history information (S110). If there is an enough free space
25 (Yes in S110), the history information processor 55

shifts the processing to S114 and continue processing.
 On the other hand, if there is not sufficient free space
 (No in S110), the history information processor 55
 erases a part of the history information 330 which is
 5 already recorded in the data recording medium 800, so
 that a free space is created. Specifically, the
 history information processor 55 refers to the history
 information date and time 33111 and 33121 of the drive
 history information 3310, and deletes the information
 10 sequentially from the one being older in date and time.
 In addition, information relating to a predetermined
 specific road (a road which is not significant as
 history information, such as a narrow road) is deleted
 (erased) (S112).

15 [0061]

As thus described, when a sufficient free space
 is reserved to record the information items left in
 S108 this time, the history information processor 55
 records those information items in the data recording
 20 medium 800 (S114).

[0062]

It is to be noted that the link travel time 3124
 is obtained based on a difference between the link
 entering date and time 3312 and the date and time of
 25 going out of the link (next link entering date and

time).

[0063]

Accordingly, the drive history information 3310 as shown in FIG. 6 and FIG. 7 is created.

5 [0064]

Next, the history information processor 55 obtains a recording ratio 3350 by the following expression. It is to be noted that the "number of information" in the following expression indicates the
10 number of items (number of fields) of the information.

Recording ratio = (the number of information items having already been recorded + the number of information items recorded this time) / {(the number
15 of information items having already been recorded) + (the number of information items collected in S104)}

Then, the recording ratio 3350 being obtained is recorded in the data recording medium 800. If it is
20 already recorded, the recording ratio 3350 is updated (S116). Then, the history information processor 55 returns to S102 and repeats the above process. According to the procedure above, the drive history information 3310 is accumulated.

25 [0065]

In addition, the recording ratio may also be obtained by the following expression.

Recording ratio = {(the number of information items
5 excluding the information items which are not subject
to recording according to user's directive) / (the
number of all information items as recording target)}.

In the above description, a process for creating
10 the drive history information 3310 has been explained.
Another process for creating the history information
will be explained in the following.

[0066]

Creation of the operation history information
15 3320 is carried out as the following. In other words,
the history information processor 55 receives via the
in-vehicle LAN, the operational information (ON/OFF
information as to blinker, wiper, parking brake, and
the like, open and close information of the doors,
20 lighting status information, brake operation
information, accelerator operation information, and
the like), which the user has performed against the
vehicle. Then, the history information processor 55
records those operation information items in the data
25 recording medium 800 together with the detection date

and time.

[0067]

Creation of the route searching history information 3330 is carried out as the following. In other words, the route searching section 42 accepts a designation of searching conditions (travel time priority, travel distance priority, highway priority, etc.), and makes a search for a recommended route from a departure place to a destination. The history information processor 55 receives from the route searching section 42, the route searching condition, the departure place, the destination, and a route of the recommended path. Then, the history information processor 55 records thus received information items in the data recording medium 800 together with the date and time when the route search was conducted.

[0068]

Creation of the communication history information 3340 is carried out as the following. That is, the network communication section 50 performs communication for sending and receiving traffic information with the information center 5000, periodically or in response to the user's request. The history information processor 55 receives the date and time when the communication was performed and

descriptions thereof, from the network communication
section 50. Then, the history information processor
55 records thus received information in the data
recording medium 800 as communication history
5 information 3340.

[0069]

Also for the case of recording the operation
history information 3320, the route searching history
information 3330, or the communication history
10 information 3340, if there is not sufficient free space
in the capacity of the data recording medium 800,
recording is performed after deleting old information
and reserving free space, similar to the case from S110
to S112 as shown in FIG. 12.

15 [0070]

A processing to create the history information
330 has been explained in the description above.

[0071]

[Processing for reading the history information on the
20 terminal machine]

Next, a processing will be explained, in which
the data recording medium 800 is demounted from the
in-vehicle type navigation device 1000, and inserted
in the reader/writer 904 of the terminal machine 5030.
25 It is to be noted that in the present embodiment, the

map data 310 recorded in the data recording medium 800 is rewritten with the latest map data 502 provided by the information center 5000, thereby updating the map data 330. Therefore, if the user 1 wants to update
 5 the map data, he or she demounts the data recording medium 800 from the in-vehicle type navigation device 1000, and inserts it into the reader/writer 904 of the terminal machine 5030.

[0072]

10 When the data recording medium 800 is inserted into the reader/writer 904, the processing unit 901 of the terminal machine 5030 logs on the information center 5000, via the network, according to a directive from an operator of the terminal machine 5030. It is
 15 further possible to configure the operation unit 901 of the terminal machine 5030 such that when it detects that the data recording medium 800 is inserted into the reader/writer 904, the operation unit 901 automatically logs on the information center 5000.

20 [0073]

FIG. 13 is a flow diagram showing a flow of processing of the information center 5000 when the data recording medium 800 is inserted into the reader/writer 904 of the terminal machine 5030.

25 [0074]

Firstly, the operation unit 901 of the information center 5000 accepts logon from the terminal machine 5030 (S202). Next, the operation unit 901 of the information center 5000 instructs the terminal machine to specify information which is to be updated.

[0075]

In receipt of this instruction, the operation unit 901 of the terminal machine 5030 accepts a selection of information to be updated from the operator via the input unit 906.

[0076]

FIG. 14 is an illustration showing a transition example of screens which are displayed on the output unit 905 in the case above. As illustrated, the operation unit 901 of the terminal machine 5030 displays on the screen 511 which accepts selection whether the entire map data is updated or data of a particular spot (name, address, phone number, and the like) included in the map data is updated. If it is selected that the map data is updated, a screen 520 to accept a selection of an area as to which the map data is updated is displayed. The area of the map data to be updated may be selectable from the following:

whole country, around the current position (e.g.,

within the radius of 100m), within a city, and within a prefecture; or in the unit of mesh. When any of the options is selected and an information item to be updated is specified, the operation unit 901 of the terminal machine 5030 transmits the selection (information to be updated) to the information center 5000.

[0077]

According to the procedure above, when the information to be updated (the area of the map data to be updated) is specified, the operation unit 901 of the information center 5000 determines whether or not there exists the latest information in its own storage unit (S206). Specifically, it is determined whether or not its own external storage unit 903 stores information corresponding to the information to be updated, being specified in S204 and that is newer than the information being recorded in the data recording unit 800. It is to be noted that this decision is made by referring to the information (version information, and the like) which specifies the created date and time of the information. If there is not any new information (No in S206), the operation unit 901 of the information center 5000 instructs the terminal machine 5030 to display a message notifying that there

is no information to be updated. In receipt of this, the terminal machine 5030 displays this message on the output unit 905 (S224). Then, the operation unit 901 of the information center 5000 finishes the processing
5 against the data recording medium 800.

[0078]

On the other hand, in the case where the external storage unit 903 in the information center 5000 records information newer than the information recorded in the
10 data recording device 800 (Yes in S206), the operation unit 901 in the information center 5000 instructs the terminal machine 5030 to read the history information 330. Then, the operation unit further instructs to transmit thus read history information 330 to the
15 information center 5000. In receipt of this instruction, the operation unit 901 of the terminal machine 5030 reads the history information 330 recorded on the data recording medium 800 via the reader/writer 904, and transmits the read-out
20 information to the information center 5000.

[0079]

Next, the operation unit 901 in the information center 5000 calculates an update charge, according to the following expression, based on the information
25 range to be updated (an area in the map data) and the

recording ratio information 3350 of the history
 information 330. It is to be noted that the update
 charge and a commission charge according to the
 information range to be updated in the following
 5 expression are predefined.

Update charge = (update charge according to the
 information range to be updated) × (1 - recording
 ratio) + commission charge

10

A formula which changes linearly according to the
 recording ratio may not be employed. The update
 charges may be predefined in incremental steps
 according to the update charge and recording ratio. It
 15 is further possible to define the minimum amount of
 the update charge as a basic rate.

[0080]

When the update charge is calculated, the
 operation unit 901 in the information center 5000
 20 transmits to the terminal machine 5030 the update
 charge thus obtained, and in addition, instructs to
 display the update charge. In receipt of this
 instruction, the operation unit 901 of the terminal
 machine 5030 displays the update charge on the output
 25 unit 905 as shown in the reference numeral 531 in FIG.

14 (S212).

[0081]

Next, the operation unit 901 in the information center 5000 accepts a request for updating the map data via the terminal machine 5030. As shown in FIG. 14, reference numeral 532, the terminal machine 5030 may firstly accept a selection of payment of update charge, either in cash or by credit card, and then accept the request for updating. Alternatively, the terminal machine 5030 may be equipped with an amount reader to read the amount of cash or a card reader which reads the credit card, and after confirming the payment, the machine may accept the update request.

[0082]

When the update request is accepted (Yes in S214), the operation unit 901 in the information center 5000 reads the information necessary for rewriting the map data in the data recording medium 800, from the latest map data 502 in the external storage unit 903. Then, the information thus read out is transmitted to the terminal machine 5030 (S216). Even more particularly, the operation unit instructs the terminal machine 5030 to delete the history information 330 recorded in the data recording medium 800, and to rewrite the map data 310. In receipt of this instruction, the operation

unit 901 in the terminal machine 5030 deletes the history information 330 in the data recording medium 800 via the reader/writer 904, and rewrites the map data 330 (S218).

5 [0083]

Next, the operation unit 901 in the information center 5000 instructs the terminal machine 5030 to display that the processing is completed. In receipt of this instruction, the operation unit 901 in the terminal machine 5000 displays that the processing is completed on the output unit 905 (S220). Then, the operation unit 901 in the information center 5000 finishes the processing of updating map data.

[0084]

15 In the description so far, there has been explained a processing which is performed in the case where the data recording medium 800 is inserted in the terminal machine 5030.

[0085]

20 It is to be noted that the processing flow as shown in FIG. 13 does not necessarily follow the sequence as illustrated. For example, accepting of selection of information to be updated (S204) may be performed, after carrying out reading of the history information
25 (S208).

[0086]

In the flow above, after deleting the history information in the data recording medium 800, the map data is updated. It is further possible to read and
 5 save the other information (user information 320, music data, and the like) recorded in the data recording medium 800, temporarily into the external storage unit 903 of the terminal machine 5030. Then, the data in the data recording medium 800 is erased,
 10 the latest map data is written in, and thereafter the user information is written again. According to this procedure, it is possible to suppress fragmentation of data in the data recording medium 800.

[0087]

15 The update charge is determined according to the recording ratio of the history information. However, it is further possible that the operation unit 901 in the information center 5000 determines whether or not the history information is recorded in the data
 20 recording medium 800 in S208, and if it is not recorded, the map data is not updated.

[0088]

Alternatively, if the history information is configured by the user that it is to be recorded, the
 25 operation unit 901 in the information center 5000 may

update the map data irrespective of whether or not the history information is recorded in the data recording medium 800. Specifically, if the user configures the history information such that it is to be recorded, 5 the history information processor 55 of the in-vehicle type navigation device 100 allows the data recording medium 800 to store information indicating such configuration. The operation unit 901 of the information center 5000 determines whether or not the 10 data recording medium 800 includes the information indicating that the user configures the history information such that it is to be recorded, and if such history information is included, the map data is updated. With the procedure above, it is possible to 15 prevent an inconvenient case that the map data is not updated due to the reason that the history information is not recorded, even though the user oneself intends to providing history information.

[0089]

20 It is further possible that even when there is no information to be updated, reading the history information may be performed.

[0090]

The data recording medium 800 processed by the 25 terminal machine 5030 as described above is again

installed on the in-vehicle type navigation device
1000, and accumulation of the history information 330
is carried out (S100). On the other hand, the
information center 5000 accumulates the history
5 information 330 received from the terminal machine
5030 as probe information 303. The probe information
303 thus accumulated is used in various ways. In the
present embodiment, as one example of the usage, a case
where statistical traffic information 504 is created
10 and utilized will be explained.

[0091]

[Statistical traffic information creating process]

Hereinafter, a process (S300) in which the
statistical traffic information 504 is created from
15 the probe information 503 that is collected in the
information center 5000.

[0092]

FIG. 15 is a flow diagram showing a flow of the
statistical traffic information creating process. As
20 illustrated, the process to create the statistical
traffic information 503 includes a classifying process
to classify the probe information 503 (S310), and a
manipulating process to manipulate thus classified
probe information (S320).

25 [0093]

FIG. 16 is a flow diagram showing a flow of the classifying process (S310) of the probe information 503.

[0094]

5 At first, the operation unit 901 in the information center 5000 reads the history information with respect to each user, from the probe information 503 (S3102), and then, deletes the information that is not significant for creating the statistical
10 traffic information. For example, since the information collected while the parking brake is on, can be determined as information collected while the vehicle was parked, such information is deleted from the probe information 503.

15 [0095]

Next, conditions for collecting the history information (date and time, weather, and link ID) are obtained (S3106), and the history information is classified according to the collecting conditions
20 (S3108). It is to be noted that the weather is specified according to a length of time period of wipers ON/OFF, past weather record history which was collected in advance, and the like.

[0096]

25 When the above processes (S3102 to S3108) are

completed with respect to all the user's history information (S3110), the operating unit 901 finishes the classifying process to classify the probe information 503, and shifts the process to the
5 manipulating process (S320) to manipulate thus classified probe information.

[0097]

FIG. 17 is a flow diagram which shows a flow of the manipulating process (S320) to manipulate the
10 classified probe information.

[0098]

The operation unit 901 extracts information under the same collecting condition (date and time, weather, link ID), from the probe information being classified
15 (S3202). Next, the operation unit 901 obtains the link travel time with respect to each information item having been extracted. For example, since the drive history information 3310 includes the drive history information recorded every time going over a link 3312,
20 it is possible to obtain the link travel time from the point of time when going over the link. Then, the operation unit 901 calculates a moving speed from the link travel time thus obtained and the length of the link (link length) (S3204). If the drive history
25 information 3312 includes the link travel time, this

processing can be omitted.

[0099]

Furthermore, the operation unit 901 determines whether or not thus obtained moving speed goes over
5 a limit speed, and if it is over, the link travel time is recalculated using the limit speed as moving speed of the link. Then, data out of standard deviation is removed from the link travel time being obtained (S3208). An average value is obtained from the
10 remaining link travel time, and this value is assumed as a statistic score of the link travel time (S3210). Then, it is stored in the statistical traffic information 504 in such a manner as being associated with the collection conditions (date and time, weather,
15 link ID) (S3212).

[0100]

When the above procedure is completed with respect to all the collecting conditions, the operation unit 901 in the information center 5000
20 finishes the statistical traffic information creating process.

[0101]

With the descriptions above, a processing to create the statistical traffic information 504 from
25 the probe information 503 has been explained.

[0102]

The statistical traffic information as thus created is transmitted to the in-vehicle type navigation device 1000 via the network, in response to a request from the in-vehicle type navigation device 1000. Alternatively, it may be recorded in the data recording medium 800 by the reader/writer 904 in the terminal machine 5030. It is further possible to rewrite the statistical traffic information recorded in the data recording medium 800 with the latest statistical traffic information, as in the case of rewriting the map data. In other words, with reference to FIG. 13, a process to update the map data has been explained, but updating of the statistical traffic information is also possible instead of updating the map data. Alternatively, updating of the map data and updating of the statistical traffic information may be carried out simultaneously. Even in the case above, it is possible to change the update charge according to the recording ratio of the history information.

[0103]

Here, route searching will be explained, which utilizes the statistical traffic information of the in-vehicle type navigation device 1000.

[0104]

As described above, the statistical traffic information includes link travel time with respect to each collecting condition. Therefore, when the route searching section 42 of the in-vehicle type navigation device 1000 accepts a route search request, it makes a search for a route which minimizes the total cost from the departure place to the destination by the use of the Dijkstra method or the like, assuming the link travel time as a cost. In performing this search, the route searching section 42 calculates the date and time when reaching each link, and further obtains weather forecasting around the link on that date and time. Then, the route searching section 42 extracts from the statistical traffic information, a link travel time under the collecting condition that matches that date and time, and weather. Thereafter, thus extracted data is set as a cost of the link. With the procedure above, it is possible to make a search for an appropriate recommended route, which is better grounded in the reality, compared to the case where searching is made by the use of a link travel time that is uniformly defined according to the link length and road width.

25 [0105]

One embodiment to which the present invention is applied has been explained so far.

[0106]

According to the embodiment as described above,
5 information which the information center wants to collect (history information) and information which the user wants to obtain (the latest map data or statistical traffic information) are recorded on the same recording medium. The user allows a situation
10 where the information center accesses the recording medium, so as to obtain desired information. The information center utilizes that opportunity to read and collect desired information from the recording medium.

15 [0107]

Furthermore, since the update charge of the map data is calculated according to the recording ratio of the history information, it is possible to prompt the user to accumulate the history information in the
20 data recording medium.

[0108]

Furthermore, as the history information, there are recorded information items such as drive date and time, link travel time, blinker ON/OFF, parking brake
25 ON/OFF, and wipers ON/OFF. Therefore, more detailed

drive history can be collected.

[0109]

It is to be noted that the present invention is not limited to the above embodiment, but various
5 modifications are available within the scope the invention.

[0110]

For example, the history information processor
55 in the in-vehicle navigation device 1000 may use
10 encryption in recording the history information 330
in the data recording medium 800. With the
configuration above, it is possible to prevent the
history information 330 from being read by anyone else.
The encryption may be carried out using asymmetric
15 cipher, which utilizes a public key and a private key.
In S114 of FIG. 12, the history information processor
55 encrypts the history information 300 by using a
public key given from the information center 5000 in
advance, before recording the history information in
20 the data recording medium. Then, the encrypted data
is recorded in the data recording medium 800. The
private key is configured to be held by the information
center 5000. Then, in S208 of FIG. 13, after the
operation unit 901 in the information center 5000
25 receives the history information 330 being encrypted,

it is decrypted by the private key held in itself, and original history information is obtained. As thus described, since encryption and decryption are performed by different keys, confidentiality of the history information is improved.

[0111]

In the above embodiment, updating of map data, or sending/receiving the history information is performed by removing the data recording medium 800 from the in-vehicle type navigation device 1000. It is not limited to the procedure above, and the information may be sent and received via a communication cable, without removing the data recording medium 800. Specifically, the in-vehicle type navigation device 1000 is connectable with the terminal machine 5030 via the communication cable. Then, sending and receiving the history information are performed by the communication cable. The latest map data is received from the terminal machine 5030 via the communication cable.

[0112]

In the above embodiment, sending and receiving of the history information 330 between the data recording medium 800 and the information center 5000, and rewriting of the map data are performed via the

terminal machine 5030. Not limited to the above procedure, it may be performed via a network. For example, when accepting an update request from the user for updating the map data 310, the user operation
5 analyzer 41 of the in-vehicle type navigation device 1000 logs on to the information center 5000. In receipt of this logon, the operation unit 901 of the information center 5000 performs the processing flow that is shown in FIG. 13 against the in-vehicle type
10 navigation device 1000, instead of the terminal machine 5030. That is, in the situation above, the user operation analyzer 41 of the in-vehicle type navigation device 1000 performs operations that are similar to the operations performed by the operation
15 unit 901 of the terminal machine 5030. Also in the embodiment as such, the information center 5000 is capable of implementing a way to obtain the history information, in exchange for updating the map data of the data recording medium 800.

20 [0113]

<<Second Embodiment>>

The second embodiment will be explained next. Since the second embodiment has a configuration similar to that of the first embodiment, tedious
25 explanations will not be made as to the configuration

being common.

[0114]

FIG. 18 is a schematic diagram of the traffic
information collecting system according to the second
5 embodiment.

[0115]

In the present embodiment, it is considered that
history information is passed from the in-vehicle type
navigation device 1000 to the information center 500,
10 through multiple ways. Here, explanations will be
made for the case where there are two ways (S400). One
way is to pass the history information, by using
telematics, and the like. Another way is to pass the
history information, via the terminal machine 5030
15 that is installed at a car dealer and the like (S500).
In the former, mainly recent history information as
a part of the accumulated history information is
uploaded in the information center 5000. In the
latter, the entire history information stored in the
20 data recording medium 800 is considered to be a target
to be passed to the information center 5000.

[0116]

The information center 5000 holds in its own
storage unit, current traffic information,
25 traffic-jam forecasting information, and the like.

The in-vehicle type navigation device 1000 accesses the information center 5000, periodically, in response to a user's request, or when traffic information is necessary in searching a route. In order to response
5 to the request from the in-vehicle type navigation device 1000, the information center 5000 transmits current traffic information and traffic jam forecasting information, and the like, to the in-vehicle type navigation device 1000. With the
10 procedure above, the in-vehicle type navigation device 1000 obtains the current traffic information and traffic jam forecasting information. At this timing, the in-vehicle type navigation device 1000 transmits a part of the history information to the information
15 center 5000, utilizing the opportunity being accessing the information center 5000. Alternatively, the information center 5000 requests the in-vehicle type navigation device 1000 to transmit the history information. Then, the in-vehicle type navigation
20 device 1000 transmits the history information thus requested to the information center 5000, in order to response to the request.

[0117]

On the other hand, the information center 5000
25 obtains history information held by the in-vehicle

type navigation device 1000 also via the terminal machine 5030.

[0118]

When obtaining the history information through
5 two ways as such, there is a possibility that the information center 5000 obtains information overlapping already-obtained information.

[0119]

Considering this situation, in the present
10 embodiment, an identifier is attached to the information already transmitted to the information center 5000, thereby handling redundant information.

[0120]

A traffic information collecting system
15 according to the present embodiment is specifically configured as the following.

[0121]

FIG. 19 shows a flow of processing in which the in-vehicle type navigation device 1000 utilizes an
20 opportunity accessing the information center 5000 for obtaining the traffic information, so as to transmit the history information 330 accumulated in the data recording medium 800 to the information center 5000 (S400).

25 [0122]

Firstly, the history information processor 55 of the in-vehicle type navigation device 1000 extracts information to be transmitted to the information center 5000 (S402). The information to be transmitted is, for example, recent drive history information 3310, which is at a point a predetermined time before the current point of time (e.g. two hours before). It is possible to obtain whether or not the drive history information 3310 is within the predetermined period of time before the current point of time, based on the date and time 33111 when the drive history information was measured, and link entering date and time 33121. In addition, it is possible to predefine which history information is transmitted to the information center 5000. Alternatively, the information center 5000 may determine which history information is to be transmitted and make a request to the in-vehicle type navigation device 1000.

[0123]

When an identifier is attached to the history information, indicating that it has already been transmitted, the history information processor 55 excludes the history information from a target to be transmitted to the information center 5000.

[0124]

FIG. 20 shows a configuration example of the history information to be transmitted. As illustrated, in this particular example, measured date and time 33111a, position 33112a, and link ID 33113a of the drive history information 3311 every certain period of time, are targets to be transmitted.

[0125]

Next, the history information processor 55 of the in-vehicle type navigation device 1000 transmits the information extracted in S402 to the information center 5000 (S404). At this timing, this transmission may be performed after the history information to be transmitted is compressed, such as extracting a difference.

15 [0126]

In addition, the history information processor 55 attaches an identifier to the information that has been transmitted to the information center 5000, out of the information in the data recording medium 800. This identifier indicates that the history information having this identifier has already been transmitted to the information center 5000.

[0127]

FIG. 21 shows that a field for the identifier is added with respect to each record stored in the drive

history information 3311, which is stored in the data recording medium 800, and shows a status that identifiers are attached to the records of the information corresponding to the information having
5 been transmitted to the information 5000.

[0128]

A step for attaching the identifier may be performed prior to transmitting the history information to the information center 5000.

10 [0129]

With the procedure above, the in-vehicle type navigation device 1000 transmits to the information center 5000 the recent history information at the time whenever the opportunity arises.

15 [0130]

The information center 5000 accumulates thus received history information in its own storage unit. Then, utilizing the recent history information items at the time, received from several in-vehicle type
20 navigation devices, current traffic information and traffic information on forecast are created.

[0131]

Next, a case will be explained, in which the information center 5000 obtains history information
25 of the in-vehicle type navigation device via the

terminal machine 5030 (S500).

[0132]

FIG. 20 shows a flow of processing performed by the information center 500 in the case above.

5 [0133]

As explained in the case of the first embodiment, when the operation unit 901 of the information center 5000 obtains the history information stored in the data recording medium 800 via the terminal machine 5030, 10 the operation unit selects history information by record (for example, by measured date and time 33111) (S502).

[0134]

Next, the operation unit 901 determines whether 15 or not an identifier is attached to the information, indicating that it has already been transmitted to the information center 5000 (S504). When the identifier is attached (Yes in S504), the operation unit 901 searches the history information already stored, for 20 information corresponding to that information with the identifier. Then, the operation unit 901 deletes the already stored information thus searched out from the storage unit (S506). Already stored information is deleted as such, because the history information 25 obtained from the data recording medium 800 via the

terminal machine 5030 includes more detailed information.

[0135]

On the other hand, if an identifier is not
5 attached (No in S504), the processing unit 5030 just shifts the process to S508.

[0136]

In S508, the operation unit 901 determines whether or not checking as to existence or
10 non-existence of identifier has been performed with respect to all the history information, and if not all the information is not checked, the processing returns to S502, and processing continues. On the other hand, if all the information has been checked, the processing
15 is completed.

[0137]

Processes in the in-vehicle type navigation device 1000 and the information center 5000 have been explained so far, in the case where the history
20 information is collected into the information center 5000 via two paths.

[0138]

According to those processes, the information center 5000 is capable of manipulating the history
25 information items appropriately, which were

redundantly obtained.

[0139]

In addition, in S506, the redundant information is deleted, but alternatively, it is also possible that
5 it is not deleted and not used for a processing for generating traffic information.

[0140]

In addition, it is further possible that the history information processor 55 of the in-vehicle
10 type navigation device 1000 may erase from the data recording medium 800, the information being recorded therein, corresponding to the information having been transmitted to the information center 5000. With this erasing, it is possible to prevent a situation where
15 the information center 5000 obtains redundant information.

[0141]

There have been explained examples in which the present invention is applied to an in-vehicle type
20 navigation device. However, the present invention may be applied to a navigation device which is not intended to be used in a vehicle.